

Pre-Visit Activity #1

Educator Information

Water Wonders

Major Concepts:

- Water
- Water cycle

Objectives:

- Describe the movement of water within the water cycle
- Identify states of water as it moves through the water cycle
- Make a connection between water and living things

Learning Skills:

- Observing
- Inferring and Interpreting
- Organizing Information
- Predicting and Communicating

Location: Classroom

Group Size: 30 or smaller, class size

Time Considerations

Preparation - 30 minutes

Activity – One hour

Appropriate Season: Any

Materials: Cut strips from the page “Go to the head of the cloud”, Copies of student’s page (one for each group), seven envelopes, and label for each of the seven stations, picture of the water cycle

Suggested Extensions: Review the water cycle chart

Credits: Project Learning Tree - Environmental Education Activity Guide



Set- up:

1. Photocopy the page “Go to the head of the cloud” and cut the strips apart.
2. Photocopy student page for each person in the class.
3. Using paper and marking pens, make a large label for each of the seven stations: Cloud, Mountain, Stream, Groundwater, Ocean, Plant and Animal. Use those labels to set up seven stations around your classroom. At each station, put an envelope filled with the strips designated for that station.
4. Ask the students, “What is a cycle?” (A sequence of reoccurring events.) Invite them to name some cycles that are part of their life (morning, afternoon, night; fall, winter, spring, summer). Ask the students whether they have heard of the water cycle before. Divide the class into pairs. Ask the pairs to write down words that describe what they know about the water cycle or what they think the term water cycle might mean. Then ask them to write their own description of the water cycle. Ask volunteers to share their descriptions with the whole class.
5. On the chalkboard, draw a sketch of the water cycle. Make sure that the students understand the terms evaporation, groundwater and condensation. (see the glossary) Use the following questions to focus their attention:
 - a. If every living thing needs so much water, how come water isn’t used up?
 - b. Where does the water go when a puddle dries up?
 - c. Why don’t oceans and lakes dry up like puddles do?
 - d. Where does rain come from?
 - e. Do you think water always follows the same path as shown in the water cycle?
6. Explain that the water cycle is really a simplified model for looking at the “journey” of a water molecule. So students may learn more about the different paths water might take, invite them to play a game in which they each will be a water molecule. Have them use the handout, “Water Cycle Score Card” to record the path they followed in the game.
7. Divide the class up into seven approximately equal groups, and have each group begin at one of the stations.

8. Have students each remove a strip from the envelope at their station. They should read the strip and write on their water cycle score card, their current station stop, what happens to them, their destination and any words they do not understand. They should return the strip in the envelope. When you call out “cycle”, students should go to the next station as directed by their strip.
9. Repeat Step 5 about ten times or until most students have cycled through the Cloud station a couple of times.
10. Ask the students to go back to their seats, and write brief story from a water molecule’s point of view that describes the journey they just took through the water cycle. For example, a student whose journey was Mountain > Groundwater > Plant > Cloud > Ocean > Ocean > Cloud > Stream > Animal > Mountain might start a story, I was a lonely water molecule frozen in ice on top of a mountain. When the spring came and the ice thawed, I slid down the mountain and sank deep into the earth.”
11. On the chalkboard, write the names of the seven stations. Beginning with the Cloud, ask students to share all the different ways they got to the Cloud. (For example, they evaporated from the ocean or transpired from a plant.) On the chalkboard, show each response by drawing arrows to Cloud. Repeat with other stations.
12. Discuss the following questions:
 - Even though individual molecules took different paths, was anything similar about the journeys they took?
 - In the game, which stations seemed to be visited by the most water molecules, regardless of their particular journey? What can we infer from this?
 - Can you think of other parts of the water cycle that were not included in the game? (Lakes, reservoirs, rivers, wells, puddles, wetlands) Where might they be included in the cycle?
 - The water cycle is usually shown like this (point to water cycle sketch). Do you think this is a useful way to show the cycle, even if the sketch doesn’t include all the paths water might take?
 - What makes water move through the cycle? (Sun, gravity, physical properties of water) what would happen if the sun’s energy were blocked from Earth?
 - What might happen if all of Earth’s water stayed in the oceans? In the clouds?
 - How is the water cycle important to plants and animals? (It moves water to them; it makes water available at different times.)

Pre-Visit Activity #1

Student Information

Water Wonders

Water covers 71 percent of the Earth. It constitutes 50-70 percent of the weight of all plants and animals, including humans. Water consists of two parts hydrogen to one part oxygen. It can exist in liquid, vapor or solid (ice) forms. Its unique physical properties enable life to exist on Earth. Those properties include water's ability to remain liquid in a wide range of normal Earth temperatures and its ability to dissolve and transport other substances.

Water is constantly moving. In general, water evaporates from oceans into atmosphere (air), condenses into clouds, falls as rain or snow, and eventually returns to oceans through a drainage system of streams and rivers. This movement is called the **water cycle**. Energy from the sun, which allows evaporation, and gravity are the driving forces that power the cycle.

In the coldest region of Earth, water is stored for a long time as ice and hard-packed snow. But even ice and snow are in motion; the rivers of ice we called glaciers slowly melt as they move inch by inch. Icebergs break away from the glaciers and float in the ocean, slowly melting as they move



toward the equator.

The movement of water is greatly influenced by the contour of land and geologic features such as mountains, valleys and hills. A **watershed** is the area of land that guides water through small streams



toward major stream or river.

Water's movement in the watershed, in turn, creates contours of the land by **erosion** and **sedimentation**.

In addition to clouds, oceans, rivers, and valleys, living organisms are part of the water cycle. All living things need water to live because it is essential to their bodily functions. Plants and animals take in water and return it to the atmosphere as vapor (breathing, transpiring) or to the soil as liquid (excreting).

Forests greatly affect watersheds. Trees, small plants, and forest litter absorb runoff. When rain falls on bare ground, the force of raindrops can wash soil into streams,

making them muddy. But when rain falls on the forest, it drips down through leaves and branches to the forest floor. The forest's canopy, as well as layers of plants litter under trees, protects the soil from full force of rain. Tree roots hold the soil in place so that it doesn't wash away.

Forests also help improve water quality by filtering out impurities that could be potentially harmful in streams or *groundwater*. As water is absorbed by tree roots and transpired as vapor through leaves, impurities (many of which are good for the tree) remain in the tree.

Although the gradual wearing down and erosion of soil is a natural process, without proper management human activities such

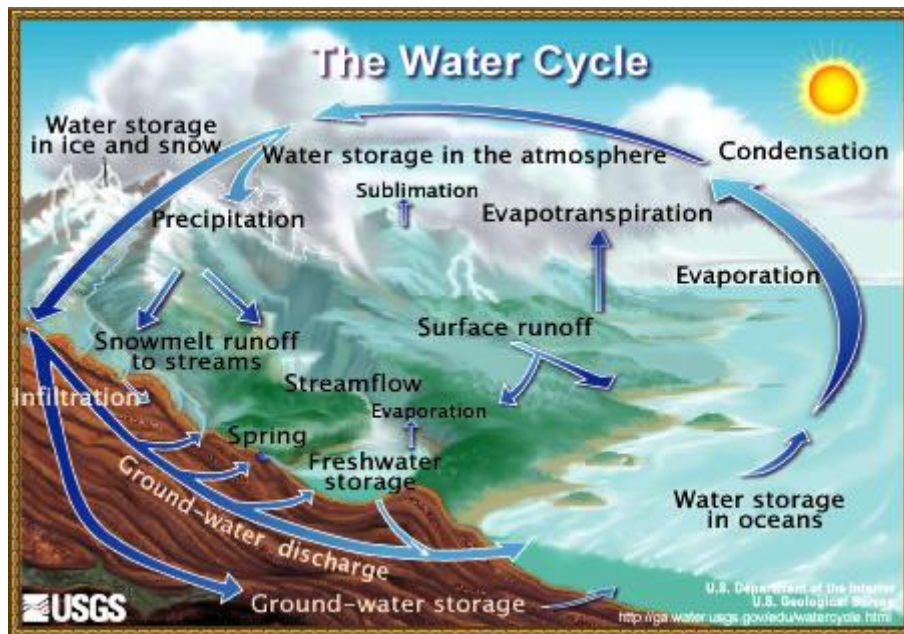
As clearing vegetation for development, logging, dam building, farming, and draining wetlands will increase the rate of erosion in watersheds and can reduce water quality. By the same token, reforestation, certain types of farming and landscaping, and restoring wetlands can reverse those trends.

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| Make copies and cut strips apart. |
| Station 1 - Cloud |
| You fall as rain onto a mountain. Go to Mountain. |
| You fall as snow on a mountain. Go to Mountain. |
| You fall as rain onto a stream. Go to Stream. |
| You fall as rain onto an ocean. Go to Ocean |
| You fall as snow onto an ocean. Go to Ocean |
| You fall as rain onto a parking lot. Go to Stream. |
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| Station 2 - Mountain |
| You evaporate into the air. Go to Cloud. |
| You soak into the ground and become part of the groundwater. Go to the Groundwater. |
| You soak into the ground and get absorbed by the plants roots. Go to Plant. |
| You roll down a hill and become part of a stream. Go to Stream. |
| You roll down a hill and become part of a stream. Go to Stream. |
| You get frozen in ice and stay there. Go to Mountain. |
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| Station 3 - Ocean |
| You are one of the countless water molecules in an ocean and you stay there. Stay at Ocean. |
| You are one of the countless water molecules in an ocean and you stay there. Stay at Ocean. |
| You evaporate into the air. Go to Cloud. |
| You evaporate into the air. Go to Cloud. |
| A kelp plant takes you in, releases you through its leaf and transpires you into the air. Go to Cloud. |
| Go to Plant, but do not draw a card. Then go directly to Cloud. |
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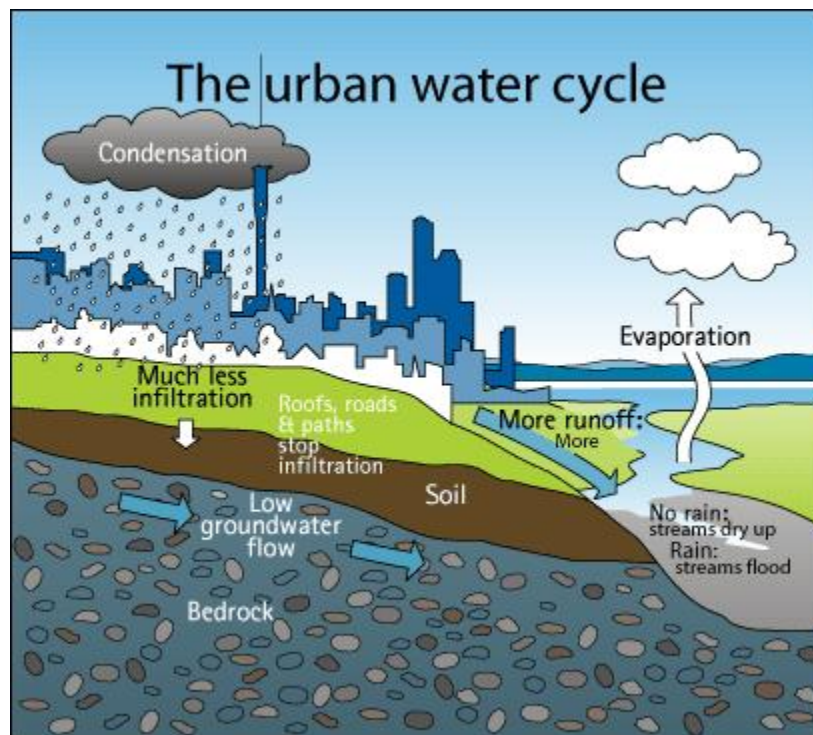
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| Station 4 - Stream |
| You evaporate into the air. Go to Cloud. |
| You evaporate into the air. Go to Cloud. |
| An animal comes to the stream and licks you up. Go to Animal. |
| You continue rolling downhill and become part of an ocean. Go to Ocean. |
| You continue rolling downhill and become part of an ocean. Go to Ocean. |
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| Station 5 - Groundwater |
| You become part of an underground stream that flows to an ocean. Go to Ocean. |
| You become part of an underground stream that flows to an ocean. Go to Ocean. |
| You become part of an underground stream that flows to a spring, where you become part of a stream. Go to Stream. |
| You become part of an underground stream that flows to a spring, where you become part of a stream. Go to Stream. |
| A plant takes you in through its roots. Go to Plant. |
| You are pumped out of the ground from a well to irrigate a farm. Go to Plant. |
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| Station 6- Animal |
| After using you to process food, the animal urinates and you end up on the ground. Go to Mountain. |
| After using you to process food, the animal urinates and you end up on the ground. Go to Mountain. |
| You are exhaled from human's lungs into the air as vapor. Go to Cloud. |
| You are exhaled from human's lungs into the air as vapor. Go to Cloud. |
| A person uses you for brushing his or her teeth. Go to Stream. |
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| Station 7 - Plant |
| The plant transpires you through its leaves into the air as vapor. Go to Cloud. |
| The plant transpires you through its leaves into the air as vapor. Go to Cloud. |
| The plant transpires you through its leaves into the air as vapor. Go to Cloud. |
| The plant uses you to grow. Stay at Plant. |
| The plant stores you in its edible fruit. Go to Animal. |

The Water Cycle



<http://ga.water.usgs.gov/edu/watercycle.html>



<http://www.aucklandcity.govt.nz/council/services/stormwater/images/urbancycle.gif>

Water Cycle Score Card

| <u>Station Stop</u> | <u>What Happens</u> | <u>Destination</u> |
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| Example Cloud | | |
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Describe your entire journey on the back of the card.

Pre-Visit Activity #2 *Educator Information* **Wetland Metaphor**

Major Concepts

- Functions of a Wetland
- Aquatic Macro invertebrate
- Indicator Species

Objectives

- Describe the characteristics of wetlands
- Demonstrate their understanding of the importance of wetlands to wildlife and humans.
- Explain and Identify what a aquatic macro invertebrate is, where it lives and how we can use them to identify the quality of the water
- Recognize why wetlands are ones of the world's most productive ecosystems

Learning Skills

- Description and Interpretation
- Discussion
- Association and Application
- Comparisons and Demonstration
- Public speaking and summarization

Location: Classroom

Group Size: 30 or smaller, class size

Time Considerations

Preparation - 15 minutes

Activity – About one to one and half hours

Appropriate Season: Any

Materials: One set materials per group is needed. Fill large paper bag with: pillow case, soap, coffee filter, sponge, baby bottle or pacifier, antacid, egg beater or whisk, cereal, sieve or strainer

Educator Information: Have the students read the information before they do the activity. Depending on the size of the class depends on how many filled pillow cases you will need per group.

Credit: Project Aquatic Wild: Aquatic Education Activity Guide, 1992, pp. 54-57

Pre- Visit Activity #2 *Doing the Activity* Wetland Metaphors

1. Review the definition of the word metaphor with your students.
2. Tell the students that you are going to give them some everyday items that represent the natural functions of wetlands.
3. Have each student make table to show- name of the item, function of the this item that could be related to wetlands and what would happen if this function was lost or removed it was changed by human actions? What would happen to specific plants or animals?
4. Pass out one Mystery Bag to each group. Ask the students to remove one item of your choice (the pillow case is a good one) from the bag. Walk and talk students through the process of recognizing the function of the item, applying to wetlands, identifying the items to be filled in the table.
5. Then have the students work with their groups, removing one item at a time, discussing the table's items to be recorded. Give them 10- minutes to complete their work.
6. Have each group present their answers for one or two items, 10-15 minutes.
7. Ask students: If wetlands are so important, then why do we have less than half of the wetlands in the United States than there were 300 years ago? Possible answers include: development (parking lots, buildings etc.), farms (the biggest factor), and mosquito control.
8. Lead a discussion about all the different problems that might be happening in the areas that used to be wetland. Students should refer to the list of functions. Possible answers include: flooding, pollution in reservoirs, less food, and fewer places to fish.

| Item | Metaphoric Function |
|--------------------------|--|
| Pillow | Resting place for migratory birds |
| Sponge | absorbs excess water caused by runoff, retains moisture for a time even if the standing water dries up |
| Wire Whisk or Egg Beater | Mixes nutrients and oxygen into the water |
| Sieve or Strainer | Strains sand, mud, debris and litter from the water |
| Coffee Filter | Filters smaller impurities from the water |
| Pacifier or Baby bottle | provides a nursery that shelters, protects and feeds young wildlife |
| Antacid | Neutralizes toxic substances |
| Soap | Cleanses the environment |
| Cereal | Provides nutrient rich |
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Pre-Visit Activity #2 *Student Information* Wetland Metaphors

Background

When you think of wetlands, what adjectives come to mind – stink, mucky, yucky or full of poisonous snakes and alligators? What good are those stinky wetlands? Why would any more in their right mind want to preserve them? Wetlands have some important functions that extend way beyond that stinky, mucky place we call a wetland. They are some of the most diverse and productive ecosystems in the world and also play an important role keeping our freshwater supply clean.

Wetlands are the source of food and shelter to thousands of different species of animals. For example, wetlands near coasts and water bodies are important in the life cycle of thousands of migratory birds like shore birds, ducks, geese, and cranes. Some of the birds just stop for a few days or weeks to rest and feed and then travel on. However, other may spend the breeding season or even the entire winter feeding and sheltering in wetlands. In addition, many species of fish reproduce and spend part or all of their life cycles in the wetlands that border water bodies. Wetlands provide food and shelter for thousands of baby fish. In turn, some of the baby fish become food for numerous birds, reptiles and mammals that also live in the wetlands.

A wide variety of insects, macro invertebrates, reptiles, amphibians, crustaceans, and bivalves feed, shelter and breed in wetlands. Animals like frogs, turtles, snakes, alligators, dragonflies, clams and crayfish all flourish in wetland habitats. Mammals such as raccoons, deer, bobcats, rodents, possums, and bears also thrive

on the abundant food supply in wetlands. What is stinky and yucky to you smells delicious and feels safe to thousands of animals who make wetlands their temporary or permanent home. What would those animals of, where would they go if wetlands were destroyed or changed?

Wetland food webs depend on millions of different plants like any other food web. The plants absorb nutrients from soil and water, energy from the sun and help cycle them through the food web. Plants also add oxygen to the water through the process of photosynthesis. Oxygen helps speed the decomposition process returning nutrients to the cycle of matter faster. Plants also help balance the nutrient concentration and neutralize toxins and body wastes through absorption and decomposition (Yes, stinky and yucky). In addition, wetland plants slow down the water flow trapping litter and debris, and allowing silt (fine sand or mud) to settle out (that's where the muck comes from). This makes the water cleaner. Slowing water slow also helps prevent erosion and flooding. Wetlands are important in controlling floods because they absorb and store excess water. When the water eventually reaches our streams rivers, lakes and oceans, it has been filtered and cleansed as it traveled through the wetlands. What would happen to the quality of our water if wetlands were destroyed or changed?

How important is clean water, food, or shelter? Wetlands may still be stinky, yucky, mucky places to you but they are invaluable in cleaning water, preventing floods and providing safe places to feed,

rest, or raise young for thousands of animals.

Where did the Sandy Creek wetlands go?

Rainwater on Duke's west campus used to infiltrate the soil and enter the ground water, gradually seeping into streams and rivers. As development increased, vegetation decreased. Rainwater now runs over impermeable surfaces, picking up pollutants, and directly enters Sandy Creek through culverts. During heavy rain falls, the torrent of water cuts deeply into stream banks and is swept downstream, rather than flooding over the stream banks and seeping into the bordering wetland. Now, these wetlands are gone. While we may never be able to perfectly restore the wetlands to what they looked like before, the goal is to restore the functions of the wetland so that it filters pollutants, controls flooding and provides habitat for plants and animals.

How is the wetland being restored?

Under natural conditions, wetlands characteristics such as soils and vegetation take hundreds of years to develop. But with wetland restoration, the goal is recreate a functional wetland in less time. The experimental wetland will help researchers better understand the processes and time frames involved in wetland restoration.

Why construct a wetland?

After heavy rain, thousands of gallons of water move across parking lots and roads, picking up pollutants along its way. The constructed wetland will intercept the water before it reaches the stream, removing many pollutants like fertilizers and petroleum products.



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| Pre-Visit Activity #3 | <i>Educator Information</i> | <u>Key to Water Quality</u> |
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Major Concepts

- Dichotomous key
- Indicator Species
- Water Quality
- Aquatic Food Webs

Objectives

- Use simple dichotomous key to identify pictures of unknown macro invertebrates
- Name at least two aquatic macroinvertebrates that are tolerant of pollution and two that are intolerant of pollution
- Give at least two reasons why macroinvertebrates are important to humans.

Learning Skills

- Observing
- Classifying
- Communicating
- reading taxonomic keys

Location: Classroom

Group Size: 30 students, class size

Time Considerations

Activity – 50 minutes

Appropriate Season: Any

Materials provided by teacher: Per student or per group: One copy of the following – Students information, Key to 10 Common Leaves; 10 Common Leaves; Key to Common Macroinvertebrates; and Aquatic Life Illustrations

Educator Information: This activity introduces students to dichotomous keys. Students will key out several macroinvertebrates, using the same key that they will use at the park during On-Site Activity #1, “Water Bugs”. Students will also learn that macro invertebrates are indicator species that help us determine water quality. A discussion of their role in aquatic food webs is included in the Student’s Information.

Credit: Eno River State Park Environmental Education Learning Opportunity

Pre-Visit Activity #3 *Doing the Activity* Key to Water Quality

Doing the Activity:

1. Have the students read the Student's Information and use the Key to 10 Common leaves worksheet. As a class, go over the answers and discuss any difficulties encountered.
2. Give each students (or group) a copy of Aquatic Life Illustrations and the Key to Common Macroinvertebrates. As a class, work through the key to identify animal #1, then have the students identify the rest of the macro invertebrates on their own.
3. When everyone is done, have individual students or groups share how they identified one of the macroinvertebrates.
4. Ask them to use the Key to Common Macroinvertebrates to determine if their organism is tolerant, intolerant or moderately tolerant of pollution.
5. Discuss the importance of macroinvertebrates as indicators of water quality and members of food webs.



Pre-Visit Activity #3 Student *Information Key* **to Water Quality**

Name that Bug

One important method for determining water quality is to look at what lives in the **water**. When you visit Sandy Creek Park, you'll be doing just that- identifying water bugs!

The number of **organisms** you find in the wetlands and creek and the diversity of species will tell you if the wetlands or creek is healthy. Excellent water quality is indicated by; you'll the presence of a large number of different kinds of organisms, especially those intolerant of pollution. Examples of animals that require excellent water quality are stoneflies, freshwater mussels and water pennies. Only certain kinds of animals are able to live in polluted water. If the acidity of the water is too high or if the **dissolved oxygen** is too low, most aquatic animals cannot survive. Examples of animals that are tolerant of pollution are black fly **larvae**, leeches and certain types of worms.

In this activity meet some of the animals that live in Sandy Creek and Sandy Creek Park Wetlands. You'll learn how to identify or classify them using a dichotomous key. A dichotomous key divides characteristics that describe organisms into two choices. At each level of the key, you will pick the choice that best describes the organism you are trying to identify.

How a Dichotomous Key Works

Practice using the Key to 10 Common Leaves first. Notice that the list of leaf characteristics is arranged as a series of either/or statements. For each pair of statements, only one will be the correct description of the unknown leaf. For example, if you are landed a leaf from a pine tree to identify, you would start at the top of the key with these two choices:

- 1) Leaf long and need-like, or
- 2) Leaf not needle- like.

A pine needle is long and needle-like, so you would choose 2 and continue to the next pair of choices under that side of the dichotomous key.

After you have mastered the leaf key, you can try the Key to Common Macroinvertebrates. A

macroinvertebrate is an invertebrate (animal without a backbone) that can be seen with the naked eye. Many of them are **insects** or insect larvae, but only a few are true bugs.

Macroinvertebrates also include many non-insect groups – mollusks (example: snails and mussels) and crustaceans (example: crayfish).

Notice that each macroinvertebrate's name on the key is followed by a letter "T" (tolerant of pollution), "I" (intolerant), or "M" (moderately tolerant).

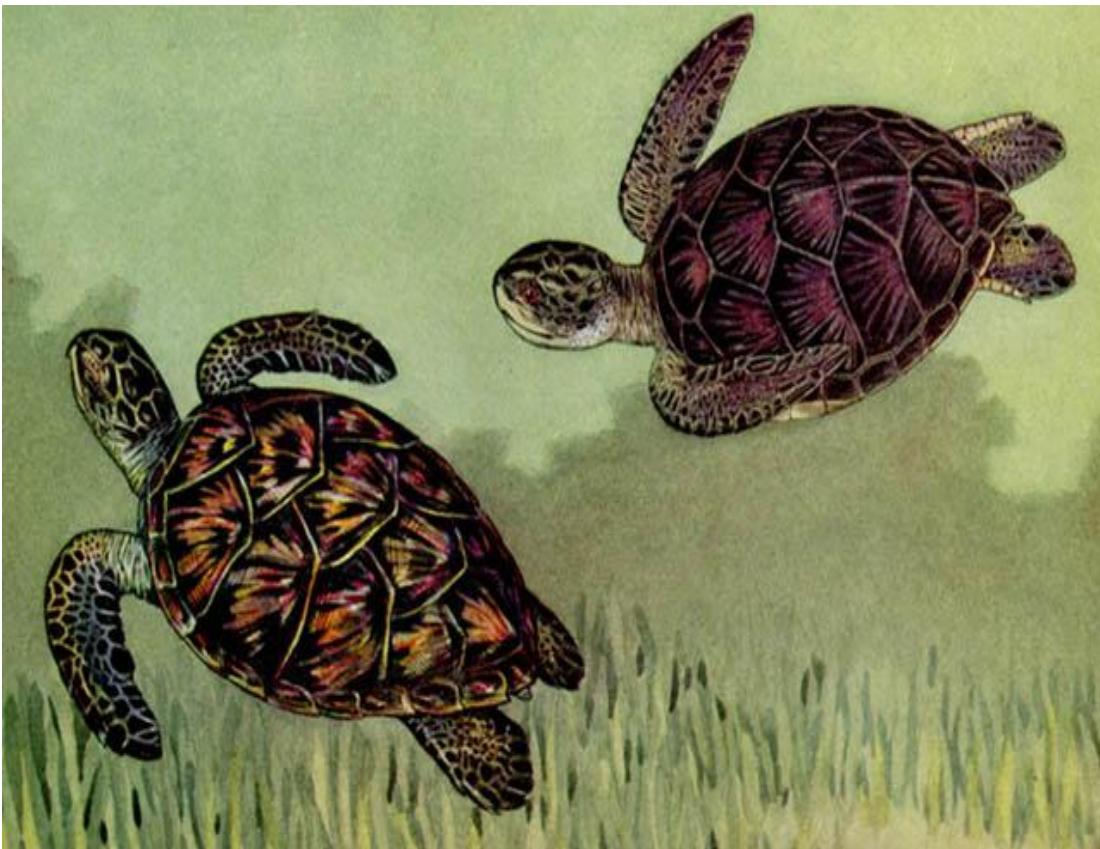
Food Webs

Many of the macroinvertebrates are predators that eat other animals; for example, the dobsonfly larva and the

dragonfly **nymph**. Others, like freshwater mussels, scuds, and caddisfly larvae, eat detritus (decaying material) in the water. Some, like leeches, are parasites on fish, reptiles or mammals. All the macroinvertebrates play an important role in the **food web** of a creek or wetland. For example, many amphibians depend on aquatic insects for food. Without them, most amphibians would starve and the food web would begin to collapse. Mussels, snails and crayfish are eaten by a wide variety

of animals, including more terrestrial species such as the raccoon.

So the next time you see an “ugly bug” in the water, don’t turn away in disgust. Learn its name by keying it out! This little animal can tell you what’s happening to your favorite swimming hole or to the water supply for your town. That’s why we call it an **indicator species** – its presence or absence can be used to determine the health of a particular environment.



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| Pre-Visit Activity #4 | <u>Do I live in a Watershed?</u> |
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Major Concepts:

- Watershed
- River Basin
- Stream identification

Objectives:

- Identify the watershed in which the students live
- Define a watershed and a river basin
- Explain the importance of protecting a watershed
- Describe stream types

Learning Skills:

- Communicating
- Inferring and predicting
- problem solving

Location: Classroom

Group Size: 30 Students, class size

Time Considerations

Preparation – 15 minutes

Activity – 1.5 hours

Appropriate Season: Any

Materials provided by the teachers: per student- North Carolina River Basin Handout, North Carolina County map; (2) aluminum pans (or boxes covered with aluminum foil), modeling clay, sponges, and a dirt/sand mixture.

Credits: Lawrence, Margaret Athey. Integrating the Sandy Creek Restoration Project with Environmental Education. 2003. p. 22-25.

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| Pre-Visit Activity #4 <i>Doing the Activity</i> Do I live in a Watershed? |
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1. Hand out copies of North Carolina River Basins and North Carolina County maps to all students. Ask them to study the handouts and compare to the county map to determine which river basin they live in. Ask them to locate to where this river drains. [Extension: after students have determined their river basins, hand out maps of your specific river basin to study the watersheds. Maps can be found at <http://www.ee.enr.state.nc.us>.]
2. Discuss the concept of river basins. Explain that the rain that falls on your roof will eventually wind up in the river of your river basin. Also explain that water runoff that goes down the storm drain ends up directly in streams that flow to the rivers (this water does not go through a sewage treatment plant). Discuss the Student Information handouts. Explain that watersheds encompass all the land that drains water into a particular body of water.
3. **Demonstration of a Watershed:** Cut a hole into the side of two aluminum pans (or use two boxes covered with aluminum foil). In each, spread a clay mixture in half of the pan, sloping upwards to represent a hill. The high end should be at the end of the pan without the cutout hole. In one box, place a sponge cut to fit, in the other half of the pan. In the other pan, spread a mixture of gravel and a few small pieces of a sponge. Explain that the pan with the sponge represents a healthy watershed with a wetland. The pan with the gravel and a few smaller pieces of sponge represents an impaired watershed. In a beaker, mix together some fine sand and dirt with a few cups of tap water. Shake vigorously. Pour into each pan at the high end of the clay, allowing time for the water to drain through the hole at the bottom. The water coming through the sponge will be significantly less and clearer than the water coming through the impaired wetland. Explain to students that wetlands help filter out sediment before it reaches the stream. In places where wetlands have been destroyed, streams get much more sediment. Explain to students that sediment and silt are considered pollutants. Muddy and silty water can clog up clams, fill up stream pools that are important fish habitat, and block sunlight. Explain how when vegetation is removed from watersheds, sediment flows right into the stream, rather than being stopped by the vegetation. Lead a discussion about types of activities that remove vegetation from the watershed (mining, poor forestry practices, poor agricultural practices, development).
4. Have students get into groups of two and brainstorm all the different reasons a stream might be important. Discuss answers.
 - a. Possible answers include habitat for fish and other aquatic wildlife, drinking water for animals, recreation (fishing, boating), and transportation.
 - b. Discuss that streams have a range of conditions that are healthy. When would rivers have a lot of water (storms, springtime, snow melts)? When would streams not have a lot of water (deserts, droughts)? Human

activities that change streams beyond this range can cause many problems.

- c. What sorts of activities might change a stream (dams, rechannelizing)?

5. Discuss stream terminology:

Three different types of streams:

- a. Ephemeral - Lasting a short time; a stream that does not flow year round.
- b. Intermittent - a stream that flows only periodically throughout the year.
- c. Perennial - A stream that would normally be expected to flow throughout the year

Three parts of a stream/river:

- a. headwater - The area just above the beginning of a stream
- b. transfer zone - The area that receives sediment from upstream
- c. depositional zone - the area where the slope flattens from a build-up of sediment over time



Pre- Visit Activity #4 - Student Information- Do I live in a Watershed?

Background Information

Fresh water is vital to life on this planet. Yet, the **ecosystem** upon which our fresh water depends is being destroyed at an alarming rate. Healthy **freshwater** are important to the many creatures and plant life that rely on water for life. These ecosystems are also invaluable to our society and economics. Flood control, healthy fisheries, recreation, and waste treatment are just a few of the many benefits provided by healthy freshwater ecosystems.

In order to better understand many of the problems and solution facing our freshwater ecosystems, it is necessary to have a basic understanding of their underlying structures and functions. Of all the water on the Earth, less than 2.5 percent is freshwater. The majority is ties up in **glaciers** and **ice caps**, leaving less than 0.8 percent as accessible freshwater. Freshwater ecosystems are connected to and dependent upon the **watersheds**, **groundwater**, rivers, and streams within which the water flows.

River Basins

All of the land which supplies water to a river is a **river basin**. North Carolina has 17 river basins with the majority spanning the state border. Depending on location, the rivers will eventually drain into either the Atlantic Ocean or the Gulf of Mexico. Take a look at your North Carolina river basin handout.

Watersheds

Watersheds are similar to river basins as they also encompass the land that drains into a body of water. Unlike river basins, watersheds can drain into tributaries, streams, estuaries or rivers. Thus, a river basin is made up of many different watersheds, while being a watershed in and of itself. The US Environmental Protection Agency defines a watershed as “an area of land that drains water, sediment and dissolved materials to a common receiving body or outlet. Watersheds vary from the largest river basins to just acres of less in size.” Watershed **ecology** is complex in that it encompasses both **terrestrial** and aquatic ecosystems. Watersheds include upland areas, lakes, rivers, groundwater systems, and wetlands and all of these ecosystems are interconnected. Watersheds also transport and store water and sediments.

Watersheds are becoming increasingly impaired. Humans have dramatically altered the entire system of watersheds including streams and wetlands. Agents of change include dams, agriculture, mining, fire suppression and the introduction of non-native species. Numerous problems are resulting such as a loss of stream biodiversity, flooding, and polluted water. Understanding the interconnected workings of a watershed is necessary for environmental managers to properly address concerns with regards to the health and functioning of watersheds.

Stream Corridors

A stream corridor generally consists of the stream channel, **floodplain**, and transitional higher level land. There is a range within which stream flows are normal. A healthy stream is able to tolerate a range of water conditions, from floods to droughts. Base flow in a stream is defined as the amount of water present between storm events.

The water present during this time influences the habitat of aquatic organisms. Frequent floods, defined as occurring every two years, are important for sediment transport and turning over the stream bed. Extreme flood events, defined as occurring once or twice every hundred years, are responsible for completely flushing the stream channel, creating new habitats, and helping to eliminate exotic plant and animal species. Flooding under natural conditions is a healthy part of a stream's life. However, flooding at more frequent intervals can occur when development exerts pressure on the normal stream flows during storm situations.

Impervious surfaces deliver an excessive amount of water into streams at much higher rates than would happen under normal circumstances. As a result, flooding occurs at greater intervals. Understanding flow ranges enable stream restoration experts to balance the needs of the stream with the current demands placed on the stream. The amount of water in a stream is directly related to the stream's characteristics. Many aquatic species are highly sensitive to temperature changes which occur

when there is less water in the stream channel. Less water in the stream channel also increases pollutant concentrations and reduces aquatic habitats as pools dry up. Understanding the amount of water necessary to keep the stream functioning normally is of primary concern for stream restorationists.

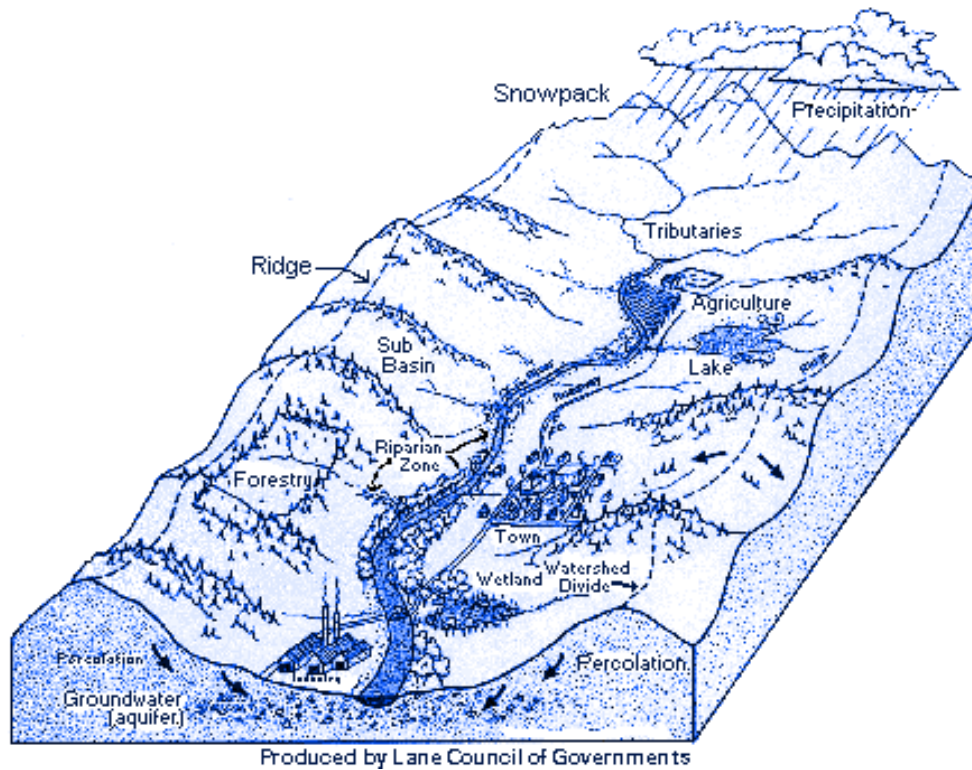
Nearly all streams exhibit some amount of sinuosity that is dictated by water flow and the way the land is formed. Problems occur when humans unnaturally straighten streams, forcing them to fit inside new boundaries. Reducing **sinuosity** reduces the stream length.

This in turn increases water flow and can result in **erosion** and **deposition** problems. Stream structure also exhibits a combination of **pools** (deeper areas) and **riffles** (shallow areas) that vary from stream to stream. Pools are important for slowing down the water and providing habitat for aquatic species. Stream habitat is directly related to the input of sediment and organic matter. Sediment input and movement is a natural stream process and is responsible for shaping and maintaining the stream channel. However, sediment becomes a pollutant when input by humans is so great that the natural processes of the stream are disrupted.

Activities such as poor agriculture practices and construction that increase silt in the rivers are responsible for sub-standard water quality measurements in at least one-quarter of lakes. Other pollutants entering rivers and streams are nitrogen and phosphorus from

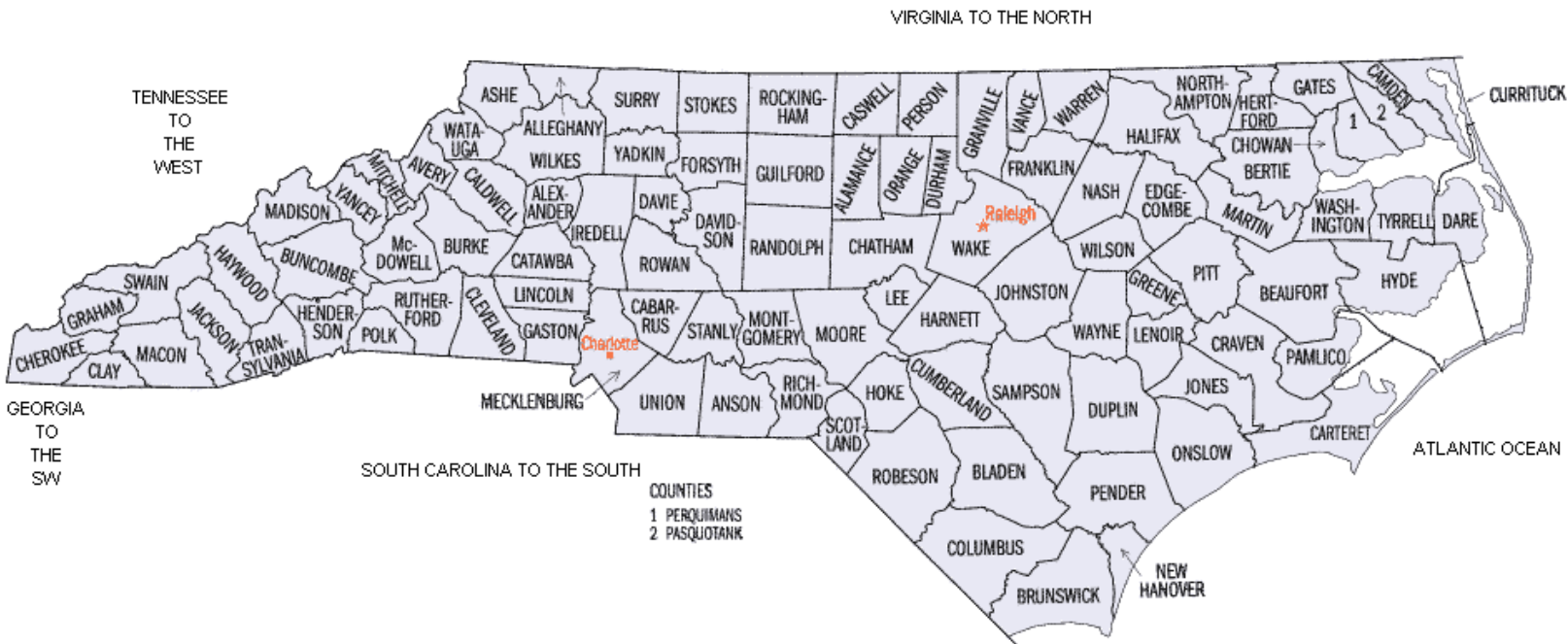
agricultural fields. These nutrients cause “**cultural eutrophication**” where algal blooms increase numbers of bacteria, leading to a decreasing amount of oxygen for aquatic species. Excess nutrients are estimated by the EPA to have been the cause of over half of the impaired lakes. Finally, other pollutants such as acid rain and petroleum products can hinder stream functions. The health of a stream is dependent on clean water entering into it from the surrounding watershed. Pollutants such as silt and nutrients and disrupted water flows will all impact the **biodiversity** of a stream. Symptoms of unhealthy streams include fish kills and the loss of any level of a **food web**. One measure of a stream’s health can be found by examining the macroinvertebrate population. Often a stream that looks clean and clear is impaired.

A Watershed



<http://www.epa.gov/win/what.html>

NORTH CAROLINA COUNTY MAP



North Carolina River Basins

